DISCUSSION OF THE AMENDMENT

Due to the length of the specification herein, Applicants will cite to the paragraph number of the published patent application (PG Pub) of the present application, i.e., US 2007/0148374, when discussing the application description, both in this section and in the Remarks section, *infra*, rather than to page and line of the specification as filed.

Claims 1 and 30 have each been amended by incorporating the subject matter of Claim 2 therein, and by inserting additional subject matter, as supported in the specification at paragraphs [0006] and [0062]. Claim 2 has been canceled.

No new matter is believed to have been added by the above amendment. Claims 1 and 3-53 are now active in the application; Claims 54-74 stand withdrawn from consideration.

REMARKS

As a preface to the rejections, discussed in detail below, the present invention is directed to tagging or marking of synthetic diamond by incorporating one or more chemical dopants into the grown diamond material. The grown diamond material consequently contains controlled concentrations of specific impurity-controlled defects that are generated by adding the chemical dopants to the gas phase of the process. The impurity controlled defects give rise to luminescence and/or phosphorescence that, under specially selected illumination conditions that are chosen to be penetrative, particularly sub-bandgap radiation that penetrates the volume of the stone and excites the luminescent and phosphorescent centers, are easily detectable. The luminescence and/or phosphorescence are specific to the CVD diamond material prepared according to the method of the invention and provide an unequivocal method of identification. The detection method is non-destructive and can be used, for instance, without removing a gemstone from its setting.

The highly penetrative radiation means that the relevant defects can be excited regardless of where they are in the diamond, rather than from just a near surface region.

The invention achieves this without imparting undesirable characteristics, such as color, to the diamond material. The method of marking becomes an intrinsic feature of the diamond material, naturally incorporated into any product formed from that material, and retained even after subsequent re-processing, but which does not in any way impact on the properties of the diamond in application.

Thus, above-amended Claim 1 is drawn to a method of incorporating a mark of origin or fingerprint in a CVD single crystal diamond material, which includes providing a diamond substrate, providing a source gas, dissociating the source gas thereby allowing homoepitaxial diamond growth, and introducing in a controlled manner one or more chemical dopants into the synthesis process in order to produce the mark of origin or fingerprint, in the form of

defect centres that emit radiation of a characteristic wavelength when excited, in the synthetic diamond material, wherein the concentration of the one or more chemical dopants is such that the mark of origin or fingerprint is not readily detectable or does not affect the perceived quality of the diamond material under normal viewing conditions, but which mark of origin or fingerprint is detectable or rendered detectable by visual detection or using optical instrumentation when exposed to illuminating light of a wavelength that has insufficient energy to excite electrons right across the band gap in diamond, that is capable of exciting the defect centres and is shorter than the characteristic wavelength of the emitted radiation.

Above-amended Claim 30 is drawn to a CVD diamond bearing such a mark of origin or fingerprint in the bulk thereof.

As discussed below, none of the applied prior art disclose or suggest the presently-claimed invention.

The rejection of Claims 1-7, 11, 21-26, 29-35, 40-49 and 51-52 under 35 U.S.C. § 102(e) as anticipated by WO 03/014427 (Linares et al), is respectfully traversed.

Linares et al discloses a method of changing the properties of CVD prepared diamond in which the amounts and/or types of impurities are modified and said to be carefully controlled. At the outset, it should be evident that the whole aim of this disclosure is to change the properties of the prepared diamond.

In one embodiment thereof, the properties are changed by the affirmative addition of impurities such as boron, for example. In an alternative embodiment, the properties are changed by lowering the nitrogen levels, for example. Regarding the affirmative addition of impurities, it is clear that there needs to be sufficient addition of the impurity to produce a measurable change in the various properties. Referring to page 13, lines 28-30, it is stated that when "**high levels** of nitrogen or boron are incorporated in the diamond, the average

distance between carbon atoms in the diamond becomes **measurably larger** than pure diamond" (emphasis added).

Linares et al acknowledges that high levels of boron addition lead to a blue colored diamond (page 16, lines 8 and 9). The disclosure refers to surgical blades that are **heavily** doped with boron and blue in color (page 16, lines 11 and 12). **Heavy** concentrations of boron and nitrogen are also referred to on page 19, lines 28 and 29. Referring to page 17, lines 1 to 3 it is stated that the "**blue** internal or external diamond layer can be provided for any use where **easy visual or optical detection of the diamond is required**" (emphasis added). Such color can be varied from light blue to black depending on the boron concentration.

Given the intention of Linares et al to change the properties of diamond, including its color and optical properties (page 12, lines 7 and 20, respectively), it is consistent that high levels of the impurities are required in order to effect the changes. Such high levels of impurities, particularly in the case of boron, lead to color changes that are visible under normal viewing conditions. It is, therefore, error for the Examiner to find that the "marks" would only be viewable under special viewing conditions; they are viewable under normal viewing conditions. The concept of "viewable" should not be confused with the concept of "detectable". "Viewable" means that the effect can be viewed and the concept is inextricably linked with vision.

Likewise, the boron impurities of Linares et al are visible under normal white light, hence the blue color. They are already detectable, and would not need to be "exposed to certain radiation" to be "rendered detectable", as suggested by the Examiner.

The chemical dopants, boron and nitrogen, referred to in Linares et al are introduced as impurities "in order to provide improved properties", and there is no disclosure or even a suggestion that these can be used to provide a mark of origin or fingerprint in the synthetic

diamond material. The only mention in Linares et al of providing a marker for identifying the original of the diamond is the use of the isotope ^{13}C (page 21, lines 11 to 21), which is specifically excluded from the chemical subject matter of the present invention. The Applicants find it telling that Linares et al identified isotopic doping as a means of providing a marker for identifying the origin of the diamond as being CVD monocrystalline diamond, but Linares et al fails to extend such marking to include doping with impurities such as boron or nitrogen. As these impurities and their effect on the properties of diamond are referenced throughout Linares et al, had Linares et al even contemplated that they could be used as a marker to identify the origin of the diamond, it is expected that such would have been stated explicitly in the disclosure. To the contrary, Linares et al draws a clear distinction between providing a marker for identifying the origin of the diamond using isotopic doping on the one hand and using impurity doping with boron for easy visual or optical detection of the diamond on the other.

In summary, the presently-claimed invention is aimed at producing a mark in diamond that can be viewed, under specialized conditions defined in the claims, such as a specified wavelength range, with a simple illuminating device, possibly with a filter and/or magnifying lens to aid the viewing of smaller objects/detail in the mark, and must not be detectable in the absence of the specialized viewing conditions. There is no disclosure in Linares et al or even a suggestion that chemical doping of CVD diamond during its production can be used as a means of providing a mark of origin or fingerprint that has no effect on the characteristic properties of the diamond under normal illumination, and hence cannot be viewed, but which becomes viewable when the marked CVD diamond is viewed under the specialized viewing conditions defined in the present claims.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 5-6, 12 and 50 under 35 U.S.C. § 102(e) as anticipated by Linares et al, as evidenced by Vlasov et al, *Relative Abundance of Single and Vacancy-Bonded Substitutional Nitrogen in CVD Diamond*, Phys. Stat. sol 181, 83, 2000 (Vlasov et al), is respectfully traversed.

For the reasons discussed above, Linares et al clearly does not anticipate the claims from which the above-listed claims depend. Vlasov et al does not remedy the deficiencies of Linares et al. Vlasov et al presents measurements of the relative abundance of N and N-V centers in polycrystalline CVD diamond. It shows that the centers used by the Applicants are known and that the emission from the 575 nm PL line is about 20 times stronger than that from the 637 nm PL line. This is not disputed. However, there is no indication that the centers or their related emissions might be used as a mark of origin or fingerprint for CVD diamond. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 1 and 7 under 35 U.S.C. § 102(e) as anticipated by US 7,160,617 (Scarsbrook et al) as evidenced by Linares et al, is respectfully traversed.

Scarsbrook et al discloses a method of making boron doped single crystal diamond in which the boron doping is uniform. In the presently-claimed invention, uniform boron doping would be unsuitable for use as a mark of origin. Further, the blue coloration in diamond caused by boron is not disputed. However, a requirement of the present invention is that the color not be visible under normal viewing conditions. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 8-9 under 35 U.S.C. § 103(a) as unpatentable over Linares et al, is respectfully traversed.

The disclosures and deficiencies of Linares et al have been discussed above. The Examiner finds that Linares et al discloses boron in a range overlapping that of the rejected claims. However, Linares et al provides an incredibly broad range of boron additions (0.03

ppm — 3,000 ppm), with little to no supporting evidence that it is able to produce products across the entire range claimed. This is exacerbated by the disclosure in Linares et al that the boron additions must be sufficiently high to measurably change the properties of the doped diamond material. It would not have been obvious that Linares et al could be followed in order to produce a product in which the characteristic properties are not affected, as the whole disclosure of Linares et al is to produce such changed properties. Further, Linares et al positively discloses the coloration of diamond using high levels of boron doping; in effect, Linares et al actually teaches away from low concentrations of boron doping, which is a key element of the present invention. Finally, following the explicit disclosure in Linares et al, one skilled in the art would not produce the claimed product of the present invention, *viz.* CVD diamond bearing a mark of origin or fingerprint that is not visible under normal illumination and that has no material effect on the characteristic properties of the marked diamond.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claim 10 under 35 U.S.C. § 103(a) as unpatentable over Scarsbrook et al, is respectfully traversed.

Scarsbrook et al has been discussed above. Thus, given the uniform boron doping of the diamond to achieve very different results in Scarsbrook et al, which are not suitable in the present invention as previously discussed, a person skilled in the art would not look to Scarsbrook et al for guidance to determine the relative quantities of boron and nitrogen in producing a mark of origin or fingerprint that does not affect the characteristic properties of the diamond. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 36-38 under 35 U.S.C. § 103(a) as unpatentable over Linares et al in view of US 6,665,058 (Gilbertson), is respectfully traversed. As should be evident from the above discussion, the coloration of diamond in Linares et al would reduce its value

as a gemstone. In any event, Gilbertson describes an adaptor for a microscope that allows the quality of the cut of a gemstone to be assessed. It has nothing to do with observing a mark in the diamond as it is simply looking at the light reflected internally as a result of the external geometry (i.e. the leakage caused by poor cutting). A layer with a concentration of defects that does not affect the color of the stone does not have any effect on the level of light leakage. Thus, Gilbertson does not remedy the above-discussed deficiencies of Linares et al. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 13-16 under 35 U.S.C. § 103(a) as unpatentable over Linares et al in view of US 5,474,816 (Falabella) and Fernandes et al, Porous silicon capping by CVD diamond" *Vacuum*, Vol. 52, 215-218 (Fernandes et al), is respectfully traversed.

Falabella and Fernandes et al are irrelevant, either alone or in combination with Linares et al, as now discussed.

Falabella describes "amorphous diamond films". An "amorphous diamond film" is not a single crystal diamond film – this would be well known to any person skilled in the art of diamond. Structurally the two are completely different materials, amorphous diamond films being non-crystalline as the name suggests. Art from the field of "amorphous diamond" is not applicable to single crystal diamond. The disclosure that an "amorphous diamond film" can be doped with silicon is irrelevant and does not imply that CVD diamond can be doped with silicon – there is much more free-volume and disorder in amorphous diamond that would allow such a large atom to be accommodated. Stress is not a particular problem in single crystal CVD diamond (and certainly not to the extent that it is in the deposition of amorphous diamond films) – the growth of thick layers is not a particular issue and therefore there would be no motivation to study how layer thicknesses might be increased from less than 1 μm to a few μm.

Fernandes et al describes coating a porous silicon substrate with a CVD diamond film. The PL spectrum referred to shows a broad spectrum from the porous silicon substrate and a similar spectrum for the coated substrate shifted by a few nm. There is no distinct PL line at 73/nm, just a part of a broad continuum of PL emission.

Combining these references with Linares et al does not provide any motivation for doping CVD diamond with silicon as a means of marking the material.

For all the above reasons, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 17-18 and 20 under 35 U.S.C. § 103(a) as unpatentable over Linares et al in view of Vlasov et al, is respectfully traversed.

As discussed above, Vlasov et al presents measurements of the relative abundance of N and N-V centers in polycrystalline CVD diamond, and that the centers Applicants use are known and that the emission from the 575 nm PL line is about 20 times stronger than that from the 637 nm PL line. There is no indication that the identified centers or their related emissions might be used as a mark of origin or fingerprint for CVD diamond. Again, viewable (in the visible sense) should not be confused with detectable. There is a clear distinction between being able to view something with the naked eye and using a spectrometer. Finally, since Linares et al already discloses colored diamond material, there is no motivation to expose it to radiation and then view the luminescence or phosphorescence.

The rejection of Claim 19 under 35 U.S.C. § 103(a) as unpatentable over Linares et al in view of Vlasov et al, and further in view of Falabella and Fernandes et al, is respectfully traversed.

For all the reasons discussed above, it should be clear that there is nothing in the above-applied art that would motivate a person skilled in the art to use silicon as an impurity for marking a diamond material in the manner recited by the present claims, nor is there any

suggestion that its associated 737 nm emission can be used as a means of detecting such a mark. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claims 27-28 and 53 under 35 U.S.C. § 103(a) as unpatentable over Linares et al in view of US 4,392,476 (Gresser et al), is respectfully traversed.

Gresser et al describes applying a mark to the surface of a diamond using a post-synthesis laser etching process. The mark is superficial and could easily be removed by re-polishing the diamond. In contrast, the presently-claimed invention requires a mark that is in the bulk of the diamond and therefore not easily removed without destroying or seriously damaging the object. It is not clear how knowledge of the superficial, easily removed by re-polishing, mark of Gresser et al combined with Linares et al would suggest the presently-claimed invention. Furthermore, the mark of Gresser would require magnification to observe under any illumination conditions as it needs to be very small in order not to degrade the appearance of the diamond and does not emit light to make itself visible. Accordingly, it is respectfully requested that this rejection be withdrawn.

The rejection of Claim 39 under 35 U.S.C. § 103(a) as unpatentable over Linares et al in view of US 5,524,458 Buchner. As Linares et al does not disclose a diamond which is marked in accordance with the present invention, no art on the shape of the material will remedy this omission. That which Buchner does or does not disclose is irrelevant. Accordingly, it is respectfully requested that this rejection be withdrawn.

In sum, nothing in the prior art applied by the Examiner discloses or even suggests, conceptually or in a practical sense, that elements such as boron, nitrogen and silicon could be added to CVD synthetic diamond at controlled levels to produce a mark that enables simple detection, but that does not impart undesirable characteristics, such a color change and the like, to the material. The method of marking becomes an intrinsic feature of the diamond material, naturally incorporated into any product form from that material, and retained even

after subsequent re-processing, but which does not in any way impact on the properties of the diamond in application. There is no prior art indicating conception of such a technique, and no prior art which indicates that the difficult balance of achieving the mark without degrading the application properties of the diamond can be achieved. Such an achievement has been made in the present invention only after extensive inventive research. Applicants are of the view that the subject matter of the claims are not only new but also inventive over the applied art.

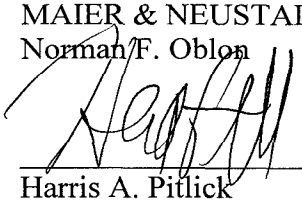
The objection to Claim 6 as being an improper dependent claim in that it fails to limit the subject matter of a previous claim, is respectfully traversed. The limitation of Claim 6 is in addition to the limitations of Claim 5. See the specification at paragraph [0009], which describes that "[t]he nitrogen doped layer may **also** show a photoluminescence line at 533 nm" (emphasis added). Accordingly, it is respectfully requested that the objection be withdrawn.

Applicants respectfully traverse the Examiner's lining out of entries for documents AJ and AS on the Form PTO-1449 for the IDS filed January 9, 2008. While the Form PTO-1449 indicates that English translations of these documents have been submitted, only partial English translations thereof were submitted. Therefore, the appropriate procedure for the Examiner was to insert the word "partial" before "English translation only" rather than not consider the documents at all. Accordingly, **submitted herewith** is another Form PTO-1449, listing the above two documents appropriately. (The documents themselves are not again submitted because they have already been submitted.) The Examiner is respectfully requested to initial the form and include a copy thereof with the next Office communication.

All of the presently-active claims in this application are now believed to be in immediate condition for allowance. Accordingly, the Examiner is respectfully requested to pass this application to issue.

Respectfully submitted,

OBLON, SPIVAK, McCLELLAND,
MAIER & NEUSTADT, P.C.
Norman F. Oblon



Harris A. Pitlick
Registration No. 38,779

Customer Number
22850

Tel: (703) 413-3000
Fax: (703) 413 -2220
(OSMMN 08/07)